## A $4\pi$ $\beta$ -tagged Decay Chamber for Gaseous SNO Calibration Sources

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In the Sudbury Neutrino Observatory detector, Cerenkov photons, generated by the fast moving electrons in the final states of the charged current ( $v_e + d \rightarrow p + p + e$ ) and elastic scattering ( $v + e \rightarrow v + e$ ) interactions, are detected by about 10,000 inward-looking phototubes mounted on a geodesic sphere. The energy of the incoming neutrino is related to the number of fired phototubes (NHIT) in an event.

One important calibration is to establish an absolute energy scale for the NHIT spectrum. This is achieved by deploying calibration devices into the D<sub>2</sub>O volume. Among the planned calibration schemes is a gaseous calibration system, comprised of a shielded underground d-t neutron generator, a capillary transport line, and an active decay chamber. The decay chamber consists of a cylindrical gas-holding volume made of 3 mm thick plastic scintillator sheets, enclosed in a water-tight stainless pressure vessel. Short-lived gamma (16N) and neutron (17N) sources are made by neutron-activating 16O and <sup>17</sup>O gases. The beta particle accompanying the decay is detected by the scintillator to provide an effective tagging signal.

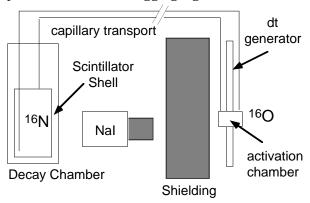


Fig. 1. Schematics of the experimental set up.

A highly successful test of the SNO d-t neutron generator, gas transport system, and decay chamber was carried out in the summer of 1996 at Chalk River Laboratory (Fig.1). The neutron generator produced approximately 108 14-MeV neutrons per second which irradiated a target cell through which oxygen gas flowed. Through the <sup>16</sup>O(n,p) reaction, <sup>16</sup>N was produced and transported through a thin capillary to the decay chamber. There the betas and 6.13 MeV gamma rays, produced by the decay of <sup>16</sup>N, were detected in the plastic scintillator walls of the decay chamber and in a large NaI detector, respectively (Fig. 2). By comparing the singles counting rate of 6.1 MeV gamma rays in the NaI detector to the rate of decay chamber-NaI coincidences, we determined that the efficiency of the decay chamber for detecting the betas from <sup>16</sup>N decay is approximately 95%. Thus this system provides a clean source of tagged 6.1 MeV gamma rays that will be used to provide an energy calibration for the SNO detector.

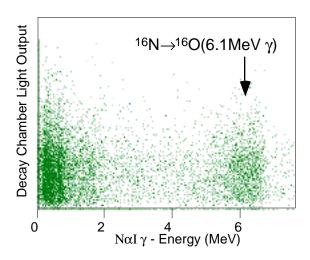


Fig. 2. Raw <sup>16</sup>N decay spectrum.

## Footnotes and References

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